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EXAMINER

KILDAY, LISA A

ART UNIT PAPER NUMBER

2829

DATE MAILED: 12/13/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

# Office Action Summary

Application No.

09/808,016

Applicant(s)

MAEDA ET AL.

Examiner

Lisa A Kilday

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

## Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

## Status

- 1) ☒ Responsive to communication(s) filed on amendment filed on 9/23/02.
- 2a) ☒ This action is FINAL. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

## Disposition of Claims

- 4) ☒ Claim(s) 8-10, 12 and 16-24 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 8, 9, 12 and 16-24 is/are rejected.
- 7) ☒ Claim(s) 10 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

## Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 23 September 2002 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

## Priority under 35 U.S.C. §§ 119 and 120

- 13) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some \* c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

## Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) \_\_\_\_\_
- 4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_

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### ***Drawings***

Drawings amended to overcome objections. Objections withdrawn.

#### ***Claim Rejections - 35 USC § 112***

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claim 16 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The term "derivative" in claim 16 is a relative term which renders the claim indefinite. The term "derivative" is not defined by the claim, the specification does not provide a standard for ascertaining the requisite degree, and one of ordinary skill in the art would not be reasonably apprised of the scope of the invention. Chemical reactivity is a most unpredictable and empirical art and it is well settled that the requirement that the claims be commensurate in scope with the enabling disclosure is particularly stringent in this area of technology. In re Doumani 126 USPQ 408, In re Grant 134 USPQ 248, In re Fisher 166 USPQ 18, Mobil Oil Corporation v. W. R. Grace and Company 180 USPQ 418, In re Slocombe 184 USPQ 740, In re Mercier 185 USPQ 774, Corona Cord Tire Company v. Dovan Chemical Corporation 192 CD 255, See In re Hawkins 174 USPQ 157 (pg. 163) reasoning is sufficient, evidence is not required.

#### ***Claim Objections***

Claims canceled to overcome objections. Objections withdrawn.

#### ***Claim Rejections - 35 USC § 102***

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The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

*A person shall be entitled to a patent unless –*

*(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.*

Claims 8-9, 16-19 are rejected under 35 U.S.C. 102(b) as being anticipated by Kohei (JP 05-343394). In re claim 8, Kohei discloses exposing a film-forming surface of a silicon oxide film to an aqueous solution containing any one of  $\text{NO}_2^-$  and  $\text{NO}_3^-$  and forming an insulating film on the film-forming surface after the film forming surface is exposed to the aqueous solution (abstract, ¶¶ 24, 26, 30-32).

In re claim 9, Kohei discloses a mixed solution containing  $\text{NH}_3$ ,  $\text{H}_2\text{O}_2$ , and  $\text{H}_2\text{O}$  as the aqueous solution (abstract, ¶ 2).

In re claim 16, Kohei discloses a semiconductor device manufacturing method comprising the steps of: a) bringing a gas or an aqueous solution containing an etchant selected from the group consisting of  $\text{NH}_3$ , hydrazine, amines, amino compounds, and their derivatives into contact with a surface of a substrate to chemically activate the surface; b) subsequent to step a), reforming the chemically activated surface with a gas or an aqueous solution containing an oxidizing agent selected from the group consisting of  $\text{H}_2\text{O}_2$ ,  $\text{O}_3$ , oxygen, nitric acid, sulfuric acid, and their derivatives to form an oxide film on the chemically activated surface; c) subsequent to step b) forming an insulating film on the oxide film as formed in step b) (abstract, ¶¶ 24, 26).

In re claim 17, Kohei discloses wherein the surface brought into contact with the etchant has a silicon oxide film or silicon nitride film exposed thereon (abstract).

In re claim 18, Kohei discloses wherein a semiconductor layer or a metal layer is additionally exposed on the surface brought into contact with the etchant (abstract).

In re claim 19, Kohei discloses wherein the etchant is an amine having a chemical formula  $NR_nH_{(3-n)}$  (abstract).

***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 12, 20-24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kohei as applied to claims 8-9 above, and further in view of Ikakura et al. (EP 1-058-301 A1).

In re claims 12, Kohei discloses a film-forming surface reforming method comprising: bringing a gas or an aqueous solution containing ammonia into contact with a film forming surface before an insulating film is formed on the film forming surface of a substrate and bringing a gas or an aqueous solution containing hydrogen peroxide ( $H_2O_2$ ) (abstract, ¶¶ 24, 26). Kohei discloses forming a silicon containing insulating film (abstract). However in re claim 12, Kohei does not teach using CVD by reacting ozone containing gas ( $O_3$ ) and TEOS to form this insulating layer. Ikakura et al. teaches that it is well known in the art to form  $SiO_2$  by CVD using  $O_3$  and TEOS (fig. 3c, abstract, ¶¶ 1-11). It would be obvious to one skilled in the art to modify the film forming surface of a substrate followed by the formation of an insulating layer as taught by Kohei, using the

conventional methods of CVD taught by Ikakura et al because modifying the film forming surface reduces roughness and prepares the film surface for deposition. Modifying the film-forming surface with ammonia and hydrogen peroxide promotes adhesion of insulating layers in order to enable the oxide formation step of Ikakura et al. to be performed.

In re claims 20, Kohei teaches that the wafer surface is changed to a hydrophobic state after cleaning the film-forming surface with  $\text{NH}_3$  and  $\text{H}_2\text{O}_2$  prior to depositing a pure thermal oxide film in order to improve adhesion. However, Kohei does not teach thermal CVD using  $\text{O}_3$  and TEOS. However, Ikakura et al. teaches the well-known method depositing an insulating layer with CVD using TEOS and  $\text{O}_3$  after cleaning the film-forming surface (abstract, claim 9, fig. 3, ¶ 64). In order to obtain a defect free film forming surface, it would be obvious to one skilled in the art to combine the methods taught by Kohei with Ikakura et al. because both methods remove dangling bonds on the film forming surface prior to deposition of Silicon oxide deposition.

In re claim 21, Kohei teaches a cleaning step (¶24) for silicon wafers and Silicon oxide films (abstract). However, Kohei does not teach silicon nitride. Ikakura et al. teaches the formation of a thermal silicon oxide film on a surface as formed by contacting a silicon nitride film with  $\text{H}_2\text{O}_2$  (¶20). It would be obvious to one skilled in the art to expose a silicon nitride film to hydrogen peroxide for the advantages taught by Kohei's cleaning step (¶ 24), which removes dangling bonds, and reduce hydroxyl groups in order to prevent peeling and blistering, and improve adhesion.

In re claim 22, Kohei teaches wherein the insulating film is a silicon containing film (abstract, technical field). However Kohei does not teach forming the film by thermal chemical vapor deposition employing a reaction gas that contains O<sub>3</sub> and TEOS. However Ikakura et al. teaches the well-known method depositing an insulating layer with CVD using TEOS and O<sub>3</sub> after cleaning the film-forming surface (abstract, claim 9, fig. 3, ¶ 64). In order to obtain a defect free film forming surface, it would be obvious to one skilled in the art to combine the methods taught by Kohei with Ikakura et al. because both methods remove dangling bonds on the film forming surface prior to deposition of Silicon oxide deposition.

In re claim 23, Kohei teaches preparing a mixed solution of NH<sub>3</sub> and H<sub>2</sub>O (abstract, ¶24). However, Kohei does not teach heating the mixed solution. Ikakura et al. teaches heating (¶84) the mixed solution at a predetermined temperature for a predetermined time so that NO<sub>2</sub><sup>-</sup> and NO<sub>3</sub><sup>-</sup> concentrations in the mixed solution are set to a desired concentration, exposing a film forming surface of SiO<sub>2</sub> to the mixed solution after heat insulating and forming an insulating film on the film forming surface after the film forming surface is exposed to the mixed solution (claim 8). Ikakura et al. (¶84-85) teaches heating the solution at a predetermined temperature for a predetermined time. Therefore it would be obvious to one skilled in the art at the time of the invention to modify the process of Kohei by heating the mixture before contacting a surface of silicon oxide in order to terminate the dangling bond of H<sub>2</sub>O to change the nature of the film from hydrophilic to hydrophobic.

In re claim 24, Kohei teaches wherein the insulating film is a silicon containing film (abstract, technical field). However Kohei does not teach forming the film by thermal chemical vapor deposition employing a reaction gas that contains O<sub>3</sub> and TEOS. However Ikakura et al. teaches the well-known method depositing an insulating layer with CVD using TEOS and O<sub>3</sub> after cleaning the film-forming surface (abstract, claim 9, fig. 3, ¶ 64). In order to obtain a defect free film forming surface, it would be obvious to one skilled in the art to combine the methods taught by Kohei with Ikakura et al. because both methods remove dangling bonds on the film forming surface prior to deposition of Silicon oxide deposition.

#### ***Allowable Subject Matter***

Claim 10 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

The following is a statement of reasons for the indication of allowable subject matter: prior art does not teach or suggest adding nitric acid (HNO<sub>3</sub>) to the aqueous solution containing any one of NO<sub>2</sub> and NO<sub>3</sub> in order to stabilize the concentration of NO<sub>2</sub> and NO<sub>3</sub> in the aqueous solution.

#### ***Response to Arguments***

Applicant's arguments filed 9/23/02 have been fully considered but they are not persuasive. For clarification purposes, the examiner would like to clarify to applicant's representative that the claims were rejected by Kohei (05-34394), not Kokai (see pg. 7 of applicant's arguments).



112 rejection for claim 16 stands. Applicant argues that the term derivative is further limited by language such as: "an etchant" and as "an oxidizing agent". This only limits the types of derivatives of H<sub>2</sub>O<sub>2</sub>, O<sub>3</sub>, oxygen, nitric acid, and sulfuric acid. The number of derivatives for oxygen is limitless. One of ordinary skill in the art would not know all the etchant derivatives of oxygen. The amount of experimentation to determine the "derivatives" is undue experimentation, thus not clear to one of ordinary skill what constitutes "derivatives".

Claim 12 canceled to overcome objections for multiple dependent claims.

Objections withdrawn.

Applicant's arguments in view of his amendments as stated in pg. 7 of his response. Nevertheless, the following explanations are provided for the points that the applicant's raised.

Arguments with respect to claim 10 are moot in view of new grounds of rejection/indication of allowability.

Kohei discloses in ¶24 a pre-washing step that includes a HF acid treatment. Applicant asserts that only after the HF treatment is a thermal silicon oxide layer formed on the Si wafer. This argument is not persuasive for two reasons. First, Kohei's HF treatment does not prevent a thermal silicon oxide layer to be formed. Secondly, the claim does not recite that the thermal silicon oxide layer not be formed after a HF treatment. Applicant argues that there is no disclosure or suggestion of a separate or sequential treatments with NH<sub>3</sub> and H<sub>2</sub>O<sub>2</sub>. This argument is not persuasive because "separate and sequential treatments" are not found in the claims. Applicant's point is

moot because this limitation is not in claim 8. Claim 9 is drawn to a mixed solution of  $\text{NH}_3$ ,  $\text{H}_2\text{O}_2$ , and  $\text{H}_2\text{O}$ . Therefore, claim 9 does not require separate or sequential treatments. Neither do claims 10 & 12. Therefore, Kohei's teaching of "ammonium/hydrogen peroxide" (¶24) satisfies the claimed limitation of mixed solution of with  $\text{NH}_3$  and  $\text{H}_2\text{O}_2$ . Applicant asserts that Kohei does not disclose that the treated surface is either a silicon oxide or silicon nitride film. The arguments are not persuasive. Claim 2 is canceled and claims 17 and 18 are new claims. Further, only claim 8 recites silicon oxide film. Kohei discloses that the treated surface is silicon oxide (abstract, technical field). Therefore, Kohei meets the claim limitation. Applicant's last argument drawn to claim 18 is moot because it is a new claim. Nevertheless, applicant contends that silicon and silicon oxide is not a type of semiconductor material. Silicon is a type of semiconductive material. Kohei teaches that the surface contains a film and a semiconductor (abstract).

Applicant asserts that the character of the surface prepared by Kohei will differ from step (a) because the "ammonia/hydrogen peroxide" step of the Kohei reference is followed by a treatment step with HF. Applicant's argument is not persuasive for two reasons. The first reason is that Applicant uses "comprising" language in claims 8-9, & 12. Therefore, applicant's method does not preclude the use of HF before, during, or after the process. Applicant's representative's assertion that the claims that the method of Kohei and Ikakura et al. will change the character of the surface is merely a conclusory observation by the applicant's representative and not supported by

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evidence. See MPEP 2145. The second reason is that the language of the character of the surface prepared is not stated in the claim.

For arguments with respect to claims 16-24 are moot in view of new grounds of rejection. However for applicant's benefit, the following points are brought to his attention.

Applicant asserts that claim 16 requires separate steps of treating with the etchant followed by treating with the oxidizing agent, which is not suggested by Kohei or Ikakura et al. It is well known in the art that HF is an etchant. HF is a derivative of  $\text{NH}_3$ , hydrazine, etc. Kohei teaches treating the film with HF, the etchant, followed by treating with the oxidizing agent (§24). Applicant's arguments that the film of Kohei and/or Ikakura et al. is different from applicant's film is repetitive. This argument has been answered in the previous paragraph.

With respect to claims 21 and 22, Kohei does not teach the formation of a thermal silicon oxide film on a surface as formed by contacting a silicon nitride film with aqueous  $\text{H}_2\text{O}_2$ . Kohei does teach forming thermal silicon oxide and exposing this film to  $\text{H}_2\text{O}_2$ .  $\text{H}_2\text{O}_2$  is part of a cleaning step, which removes dangling bonds and reduces hydroxyl groups to prevent peeling and blistering. It is well known in the art to clean a insulating films such as Silicon nitride with  $\text{H}_2\text{O}_2$ . Furthermore, Ikakura et al. teaches the formation of a thermal silicon oxide film on a surface as formed by contacting a silicon nitride film with  $\text{H}_2\text{O}_2$  (§20). Applicant asserts that Kohei does not teach the use of  $\text{H}_2\text{O}_2$  alone. Kohei teaches this because the  $\text{H}_2\text{O}_2$  solution is merely aqueous  $\text{H}_2\text{O}_2$ . The claim language in claims 21 and 22 is "comprising". Therefore,

applicant's method does not preclude the use of other treatments before, during, or after the process. Applicant argues that Kohei does not teach the formation of an insulating film on a surface as obtained by H<sub>2</sub>O<sub>2</sub> treatment. Kohei does recite forming an insulating film on a surface as obtained by H<sub>2</sub>O<sub>2</sub> treatment (abstract, ¶24). With respect to the limitation of Silicon nitride in claims 21-22 is addressed in the new grounds of rejection.

With respect to claims 23-24 of heating the solution containing NH<sub>3</sub>, Ikakura et al. provides this and it is addressed in the rejection. Furthermore, the arguments regarding additional steps are moot due to the open-ended transitional phrase "comprising" as discussed earlier.

The remainder of applicant's rejection are moot in view of new grounds of rejection.

### **Conclusion**

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any

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extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.


Any inquiry of a general nature or relating to the status of this application should be directed to the Group Receptionist whose telephone number is (703) 308-0957. See MPEP 203.08.

Any inquiry concerning this communication from the examiner should be directed to Lisa Kilday whose telephone number is (703) 306-5728. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kamand Cuneo, can be reached on (703) 308-1233. The fax number for the group is (703) 305-3432. MPEP 502.01 contains instructions regarding procedures used in submitting responses by facsimile transmission.

Lisa Kilday

LAK

12/9/02

  
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